Structural Health Monitoring (SHM)
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Lecture – 52
The sensor requirements and Data acquisition –Part 2

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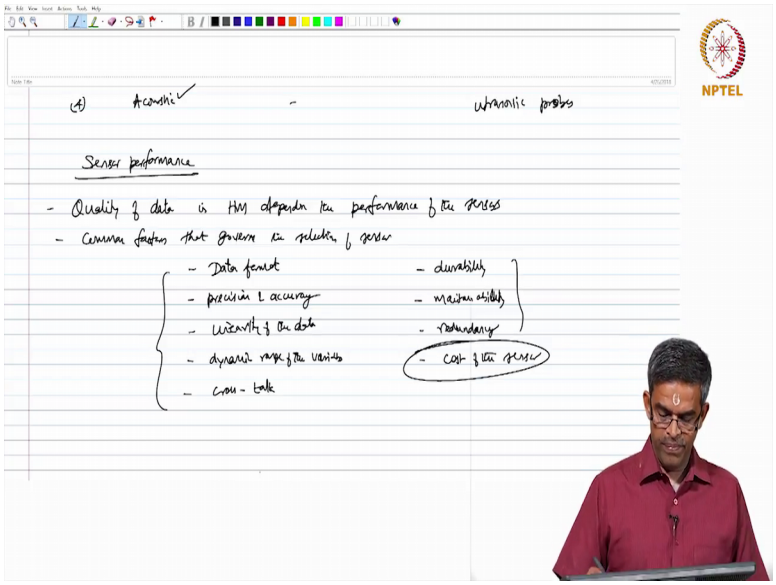

Now, let us talk about how do these factors affect the sensor performance. We all know that quality of data in health monitoring depends on performance of the sensors. Some of the common factors that govern this, govern the selection of sensor could be data format, precision and accuracy, linearity of the data, dynamic range of the variables, cross-talk, durability, maintainability, and redundancy, cost of the sensor.

Luckily, you understand the cost has been kept, as a loss parameter of priority in the factors that allow you to select the sensor. So, in offshore applications, choice of sensor, investment on the type of sensor, and the networking does not matter in terms of economic perspective, as long as the structural health monitoring system is well established for its necessity to be carried out on the specific platform.

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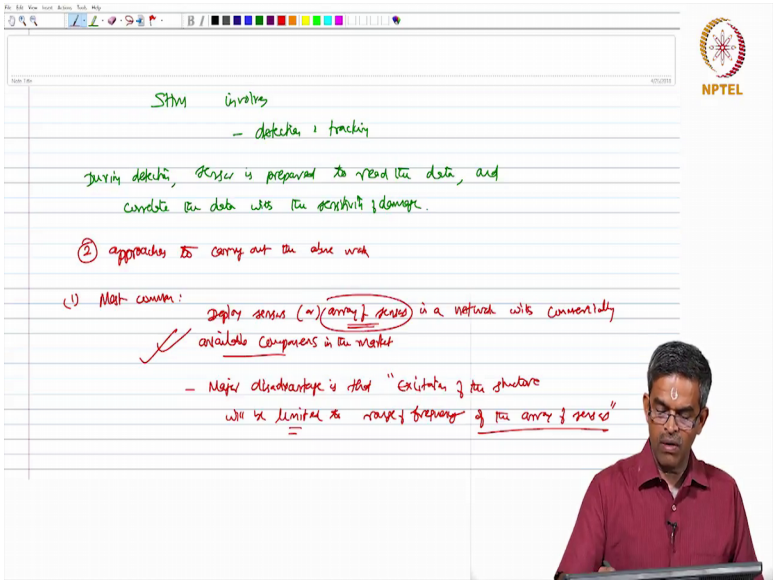

We all do know at this stage, that structural health monitoring involves various activities; for example, detection and then tracking. So, during detection, sensor is prepared to read the data, and correlate the data with the sensitivity of damage. There are two approaches by which this can be done. First approach is that which is most common as well that is deploy sensor or array of sensors in a network with commercially available components, that is the first method, by which I can do the sensing for offshore structures. So, I choose an array of sensors from the commercially available components in the market.

In this case, the major disadvantages is that excitation of the structure will be limited to the range of frequency of the array of sensors. It is very interesting problem you see, I want to study the structure instead of bothering about the limitations imposed by the structure. I am constraining my study to the limitations imposed by the sensor that is the first way, which is very commonly practiced in structural health monitoring where people pick the existing sensors and make an array a network of that, and start doing health monitoring.

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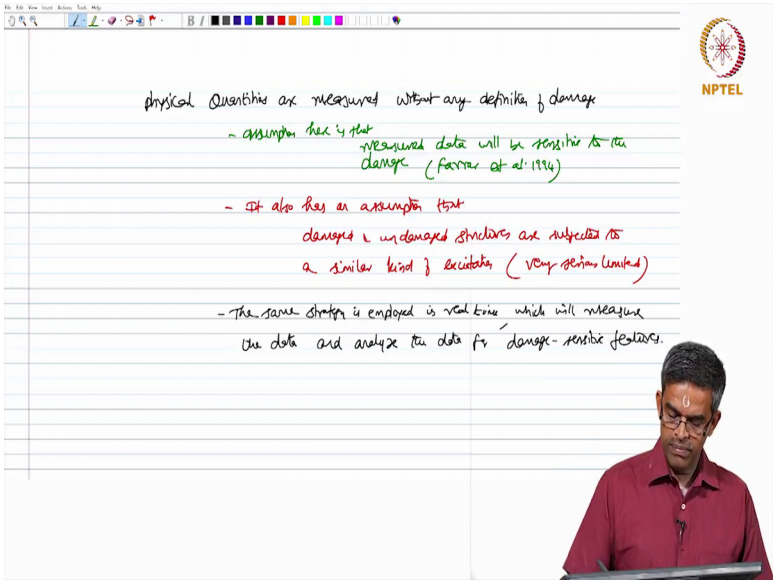

Physical quantities are measured without any definition of damage, they are simply continuously measured ok. The assumption here is that the measured data will be sensitive to the damage; I mean that is an assumption, it may not be true all the time ok. This is very clearly commented by Farrar et al., in 1994, that is imposed a very serious limitation, in terms of deploying array of known senses.

It also has an assumption that the damaged and undamaged structures are subjected to a similar kind of excitation, which is very serious limitation, please it is more serious compared to the earlier one. The same strategy is employed in real time, which will now measure the data, and analyze the data for damage sensitive features.

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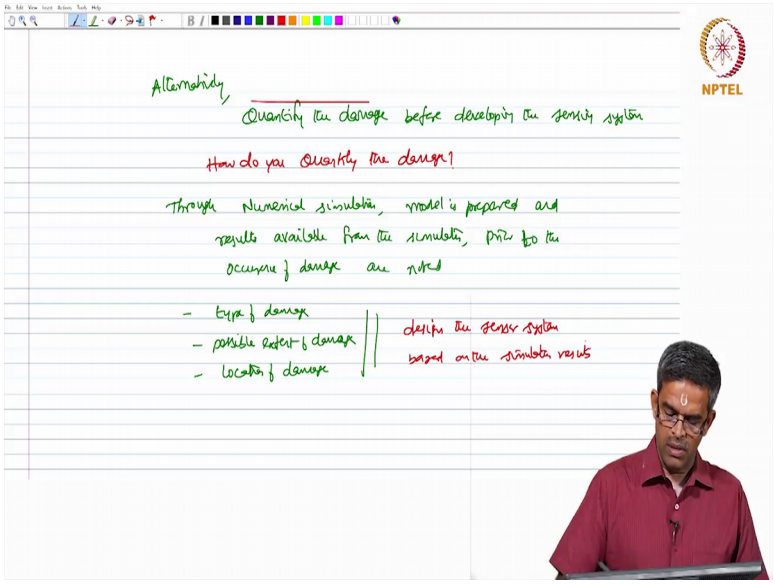

Alternatively, quantify the damage before developing the sensing system. Now, the question comes how do you quantify this damage, how do you know what would be the extent of damage, that is an interesting question. If you cannot quantify them, you cannot have any alternative method of sensing system except that pick up the array of sensors available in the market, lay them as per the directions given by the manufacturers ideas, and keep on acquiring the data and believe that the data measured by you are damage index parameters, which are will be shown significantly by the structure, which may not be true in most of the cases.

So, now the question is if you really wanted to custom design the sensing system, then you have got to quantify the damage. So, how do you quantify the damage, now to quantify the damage, we need to have numerical simulation. Through numerical simulation, model is prepared when numerical model is prepared and results available from the simulation, prior to the occurrence of damage are noted.

So, they will give the type of damage, possible extent of damage, and there are methods which can even tell you the location of the damage also, there is localization of damage based on these datas design the sensor system simulation results.

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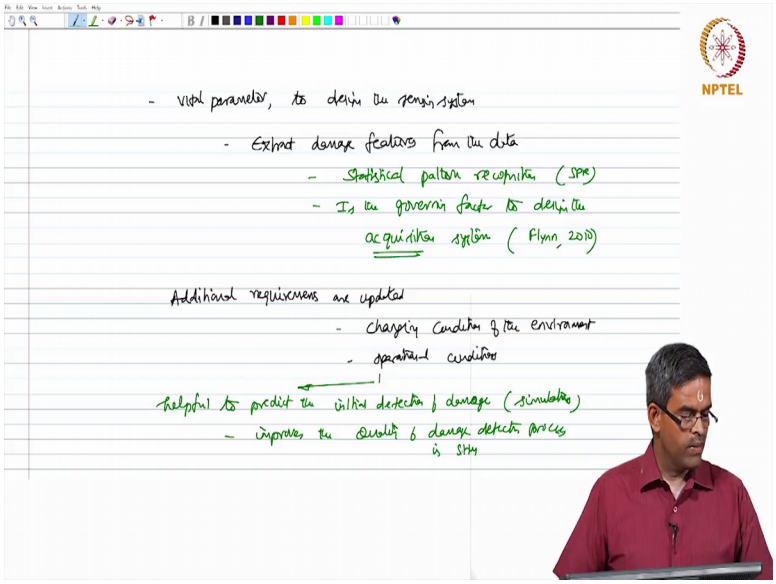

Now, when we pick up the sensor system for design, it has one more lacunae or one more vital parameter, to design the sensing system is that how do you extract the damaged information features from the data. As we already saw, we can use statistical pattern recognition, which is a very powerful tool, which we already saw in detail in the earlier lectures which is now the governing factor to design the acquisition system, we have been discussing about the sensing system.

Now, we have moved to the discussion on acquisition system, which is also verified by flying in, 2010. Now, based upon the outcome of the starter statistical pattern recognition, additional requirements are updated based on the changing conditions of the environment, and operational conditions, which also change from every phase to another phase.

Now, the operation conditions are helpful, they are helpful to predict the initial deduction of damage, which can be done by numerical simulations, this improves actually the quality of damage detection process in SHM.

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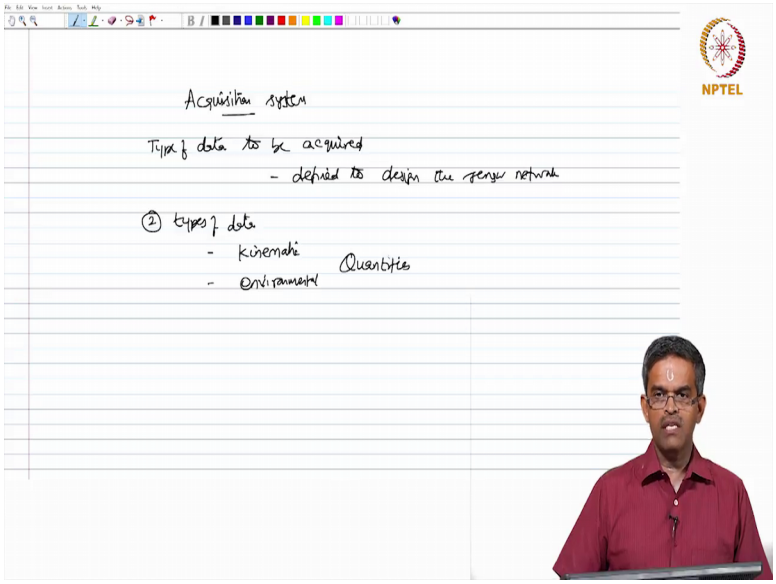

Now, the question is about the management system that is the acquisition system which is now an outcome of the statistical data or pattern recognition, which we got from the numerical simulation results, which are all are prior known to me before you design a sensing system ok. One type of SHM system is that, you lay the array of sensors, which are available in the market. Pick up the sensors as per the choice, and try to laid out them, and measure them, believing that the structure will depict its difference in behavior by these kinds of measurements, which are demanded, and which are sensed and measured by those type of sensors, which are readily available in the market.

But, if you want to really do some novelty, in terms of detecting the damage may be a different kind, where the readily available sensors are not there in an array system. You want to design the sensing system array yourself, then we have to do a detailed numerical model, subject the model to prior damage conditions, and try to identify the possible location of damage, detection of damage, initiation extension of damage etcetera. Based on which, I develop a statistical pattern recognition, which will be a governing factor for me to design my acquisition system.

Now, the acquisition system depends on the type of data to be handled ok. So, this should be defined to design the sensor network system. There are two types of data mainly, one is kinematic, and other is environmental quantities. So, how do we separate this kind of data, what are the acquisition management to be done for acquiring these kind of data,

and how sensors can be deployed to collect these data in a careful manner, and how they can be laid in a network we will see in the next lecture.

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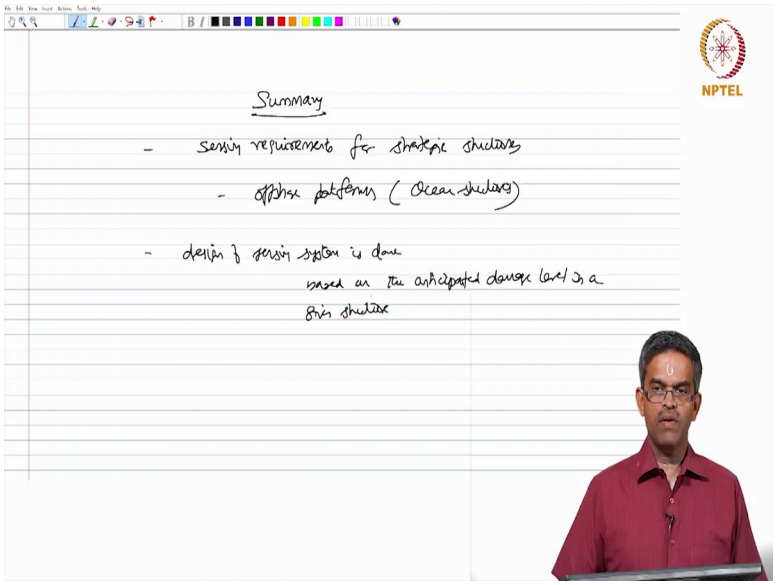

So, friends, in this lecture, we have discussed about the sensing requirements for strategic structures. We spoke more in detail about the offshore platforms, or one can say in general ocean structures. We said how the design of sensing system is done, based on the anticipated level of damage in a given structure. We are in the verge of discussing, how the data handling will be done in the acquisition system, which we will continue to discuss in the next lecture.

Thank you very much and bye.